# Accumulation versus Accomplishment as Organizing Structures for Human Activity

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The idea that human behaviour can be understood as a sequence and hierarchy of goal-directed action is one of the foundational ideas of cognitive science (Miller, Galanter & Pribram, 1960). Humans work to accomplish goals, and goals are related one to another in subgoal hierarchies, so that action can (to some extent) be planned in advance.

In applied psychology, goal-subgoal hierarchies are the foundation of hierarchical task analysis and, in Human-Computer Interaction they are the basis of the influential GOMS method for analysing the usability of interfaces.

Nevertheless, in recent years there have been various expressions of disquiet with goal-hierarchies as expressions of human activity for the purposes of design research. The word 'activity' itself is a little loaded here. Although sometimes used in a theoretically neutral way, it of course also can signal the adoption of Activity Theory as a conception of human behaviour which many authors have offered as an alternative to western cognitive science (e.g. Nardi, 1996).

There's a lot of high-level philosophical discussion about the relation between activity theory and task-analytic approaches, but for our purposes they share assumptions which we wish to challenge. Activity theorists have typically been more interested in broader timescales of behaviour, and they have also been more interested in consciousness and they have tended to emphasise the practical, institutional routines that provide environmental structure for behaviour. Nevertheless, one might wonder whether these genuine shifts in areas of interest could not in principle be accommodated within the standard cognitive models. Activity theorists seem to share with others in HCI a disquiet with classical cognitive models and in part with the construct of a task, yet at the heart of activity theory is the same idea – that human behaviour is organized to accomplish hierarchically organized goals.

We contend that the disquiet with goal hierarchies as a universal construct DOES have a basis, but that this basis has not yet been successfully articulated, either by activity theorists or by others. The issue with goal hierarchies that we wish to explore is that some aspects of some activities are better revealed by considering them in terms of the accumulation over time of a currency. This is the standard conception of foraging activity, but we suggest that it is much more powerful and widespread than has yet been explored.

Consider studying a book. There's no easily-specified single state to be accomplished. Rather the primary organizing structure is accumulation – the reader wants to gain as

much as possible (of whatever currency – perhaps pleasure or information) in the time allowed for the activity. One can imagine some way of expressing reading behaviour as goal-oriented, but it can clearly also be expressed as information foraging (Pirolli & Card, 1999) with some aspects of behaviour being determined by the reader's changing rate of gain over time.

We contend that many human activities are accumulation-oriented in this sense. The stopping rule is not the accomplishment of some pre-defined state, but rather may derive from time, or from a threshold on rate of accumulation, for example. To begin to analyse such activities, instead of describing goal-hierarchies, one needs to describe what the currency is that is being accumulated, and what gain function relates activity over time to accumulation.

Consider the task of editing an already-drafted paper. Again, one might describe this task as a hierarchy of subgoals (e.g. check the spelling of every word, check the placement of every figure, etc). But again there's often no simple goal-accomplishment stopping rule. One wants to accumulate as many improvements as possible to the paper, and the gain curve of these improvements is a classical diminishing returns curve, with improvements harder and harder won over time. One might have a fixed deadline for the actiivty, which would provide a definite stopping rule, or one might continue until the rate of gain seemed so low as not to justify further effort.

We have explored this perspective on activities as a way of investigating how people manage their time across multiple tasks. We think the perspective, and the distinction between accumulation and accomplishment might have much broader utility, but for the remainder of this paper we will focus on using this distinction in reviewing our published empirical work on time management.

Reader and Payne (2007) allowed readers to allocate limited time across a set of relevant texts, with the goal of learning about the human heart so as to write a short essay. They discovered that, unless texts were provided with explicit summaries, most readers appeared to manage their time by monitoring learning as they read, and by abandoning small patches of text (perhaps paragraphs) that failed to afford sufficient learning.

Payne, Duggan and Neth (2007) allowed problem solvers to switch between similar word-finding accumulation tasks. In two experiments participants could allocate their time across two alternative groups of letters, so as to generate as many words as possible in total. In a third experiment participants could allocate their time across two word-grid puzzles so as to find as many embedded words as possible in total. Payne et al. showed that to fully understand the effect in their data it was necessary to assume that participants were monitoring their rates of accumulation *and* sometimes treating 'find the next word' as a subgoal.

In summary, we explore the idea that full understanding of many human activities requires that they be considered in terms of accumulation of currency over time as well as the accomplishment of goals and subgoals.